THE HYDRO-GEOMORPHIC SENSITIVITY OF FORESTED WATER CATCHMENTS TO WILDFIRE

René Van der Sant
PhD candidate, Department of Forest and Ecosystem Science, The University of Melbourne

Pim Rjikee
Undergraduate student , Wageningen University & Research

Gary Sheridan, Petter Nyman and Patrick Lane
Department of Forest and Ecosystem Science, The University of Melbourne

PRESENTATION OVERVIEW

1. Background
2. Landscape sensitivity
3. Research objectives
4. Study site
5. Methods
6. Quantifying error
7. Initial findings
8. Future outcomes

FIRE AND HYDROGEOMORPHIC PROCESSES

Fire alters hydro-geomorphic processes or rates, increasing runoff and erosion

"...fire can be a potent force for change affecting all systems." (Thomas, 2001)

Photos obtained from Petter Nyman

LANDSCAPE SENSITIVITY

The probability that a geomorphic system will "produce a sensible, recognisable, and persistent response" to a change in system controls or external forcing (Brunsden and Thornes, 1979).

(Phillips, 2009) "...a framework for the assessment of geomorphic changes ... based on the 'four Rs':"

Response – the change in a system

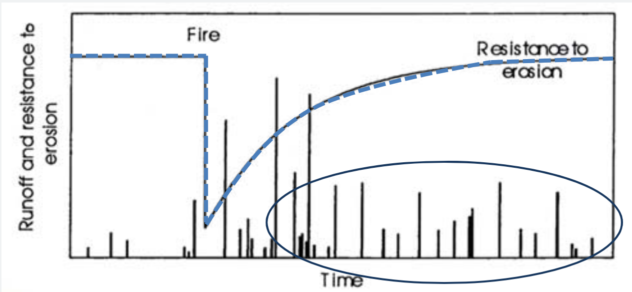
Resistance – the forces resisting change

Resilience – the recovery from change

Recursion (Feedback) – the effect of internal interactions on change

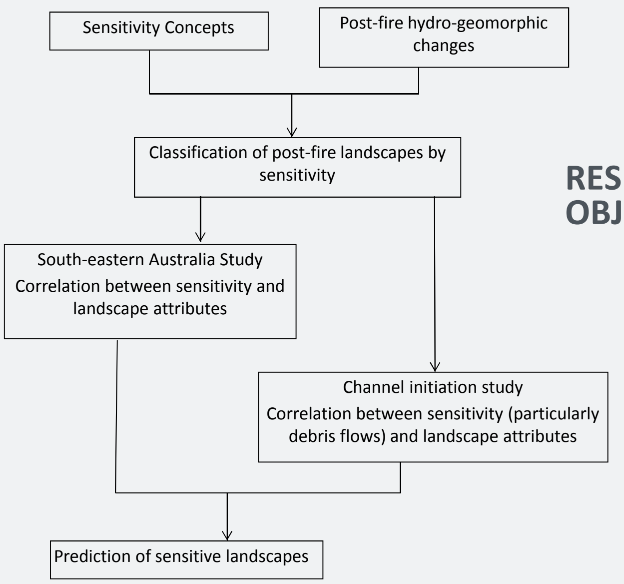
LANDSCAPE SENSITIVITY

The observed response represents the change in a threshold and is dependent on the disturbance, resistance, resilience and feedback.



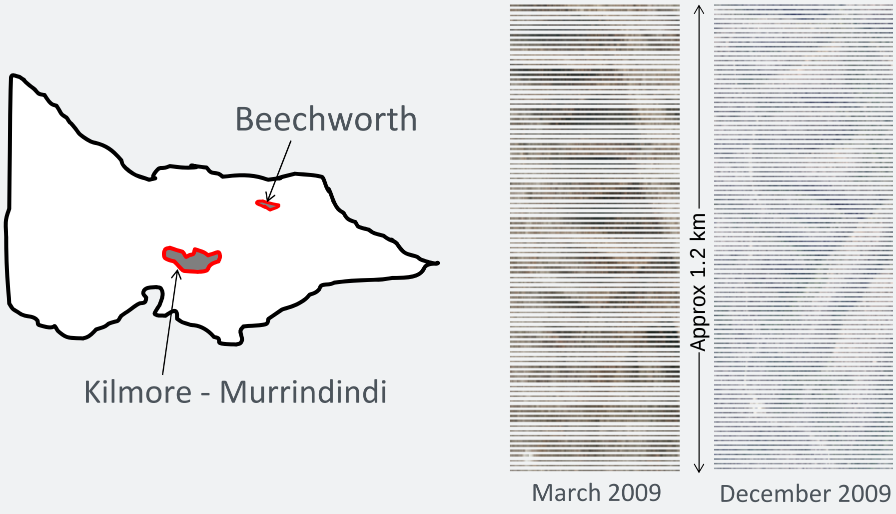
Hypothetical effect of fire on runoff and resistance to erosion (measured as event size required to generate sediment yield)*

*Prosser, I. P., & Williams, L. (1998). The effect of wildfire on runoff and erosion in native Eucalyptus forest. *Hydrological Processes, 12(2), 251-265.*



RESEARCH OBJECTIVES

AERIAL PHOTO DATA SET – 2009 FIRES – VICTORIA



Aerial imagery obtained from the DSE and NearMap Pty Ltd

DEBRIS FLOW OCCURRENCE

Debris flow mapping by Petter Nyman

MOVEMENT OF CHANNEL INITIATION POINTS

"Before" "After"

95 m

2 weeks after fire 10 months after fire

Aerial imagery obtained from the DSE and NearMap Pty Ltd

DRAINAGE AREA-SLOPE THRESHOLD

- Drainage area and slope used to estimate runoff energy for given soil type and rainfall intensity
- Once energy threshold is reached soil is transported

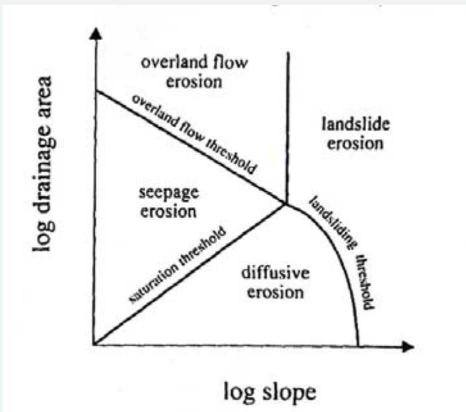


Figure 11.7 p235 Montgomery and Dietrich (1994)

QUANTIFYING AND MINIMISING ERROR

1. Need to develop a method of identifying channel initiation points (CIP)
2. Need to be able to define a channel – not as easy as you might think!
3. Need to know the error associated with method
4. Need to minimise error

AERIAL PHOTO IDENTIFICATION METHOD

The channel consists of a single, linear feature that usually extends more or less uninterrupted until its confluence with a creek or river.

From the drainage divide, follow the channel until the first position it meets these criteria for at least 5 m (Figure 1)

The distinction between rills and channels can often be made by noting the shape: rills are often bent (Figure 2).

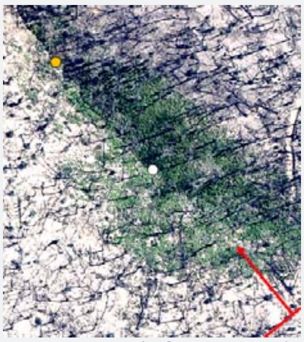


Figure 1: Search from top down

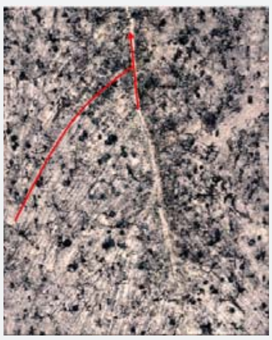


Figure 2: Rills are curved

AERIAL PHOTO IDENTIFICATION METHOD

A debris deposition, as evidenced by a sudden increase in width/length ratio of the channel, is not a CIP (Figure 3).

Upstream of a fork, each branch is treated as a separate feature that has to qualify the above criteria to identify as a channel. Thus, a fork itself is not automatically a CIP (Figure 4).

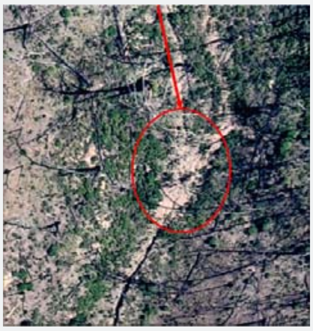
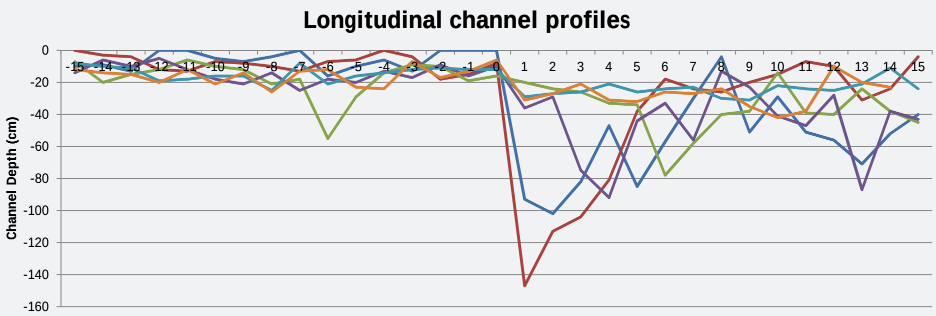
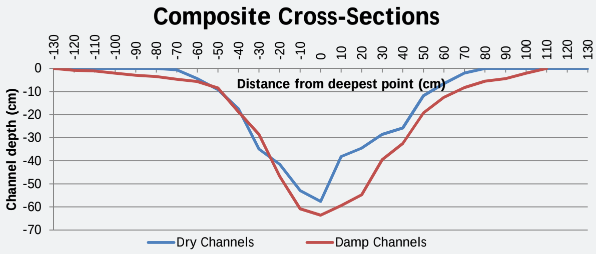


Figure 3: Debris deposition

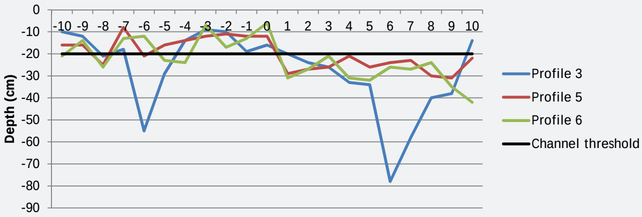
Figure 4: Fork branches are separate

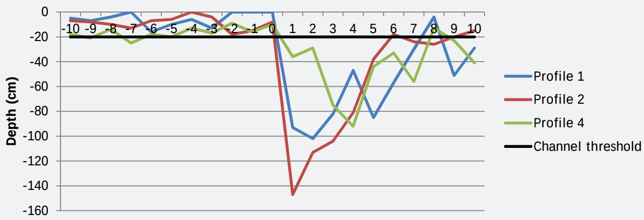
FIELD IDENTIFICATION METHOD



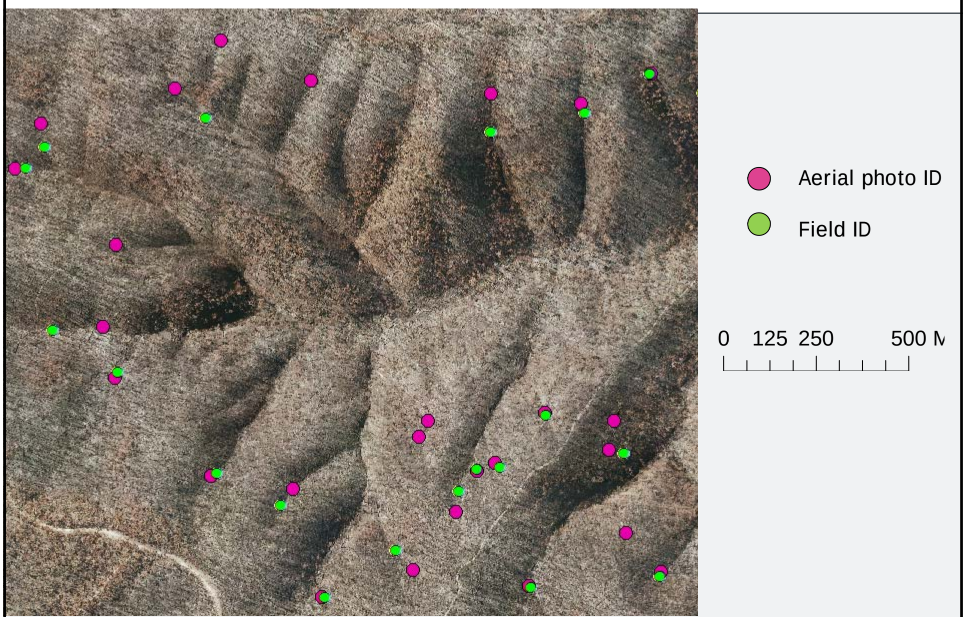


FIELD IDENTIFICATION METHOD

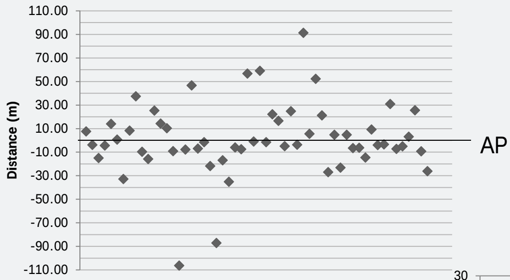


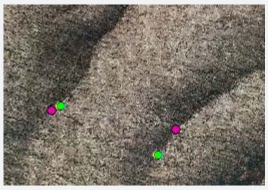


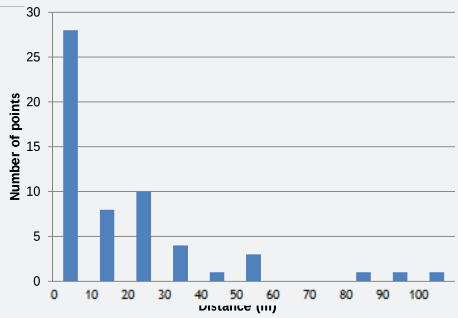
RESULTS



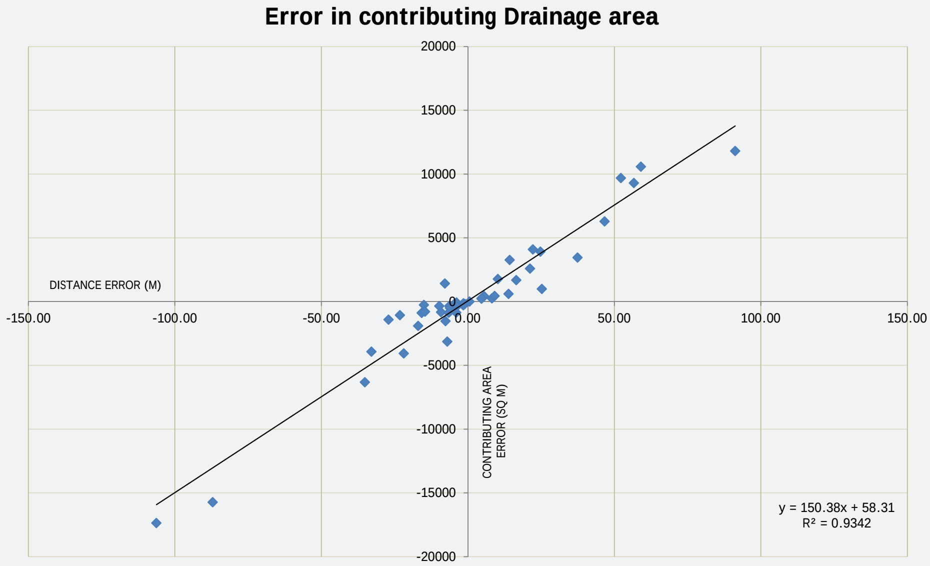
HOW MUCH ERROR WAS THERE?



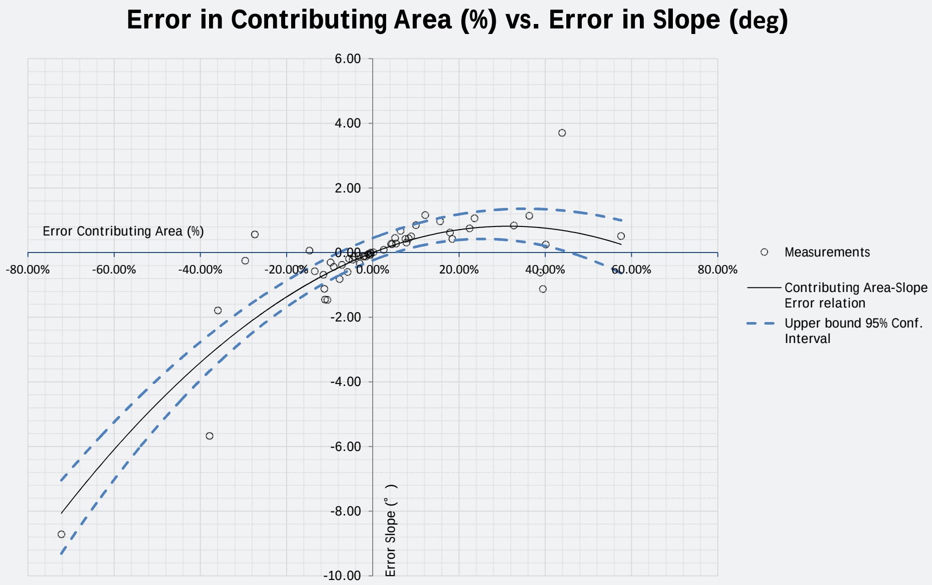




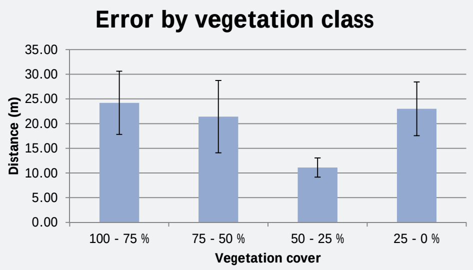
HOW DID THIS RELATE TO CONTRIBUTING CATCHMENT?

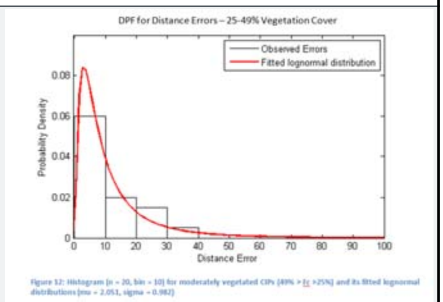


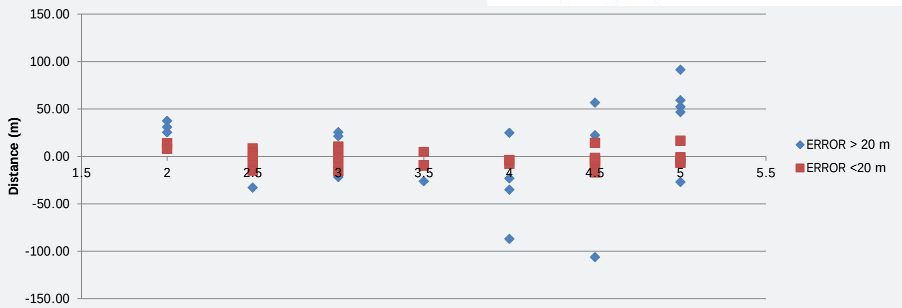
HOW DID THIS RELATE TO CONTRIBUTING SLOPE?



MINIMISING ERROR

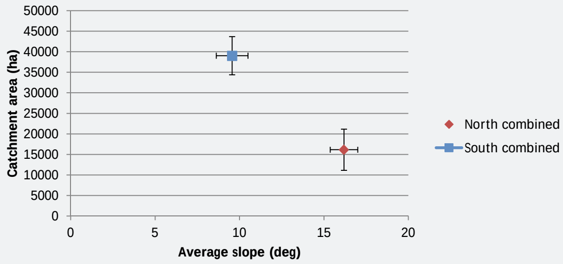


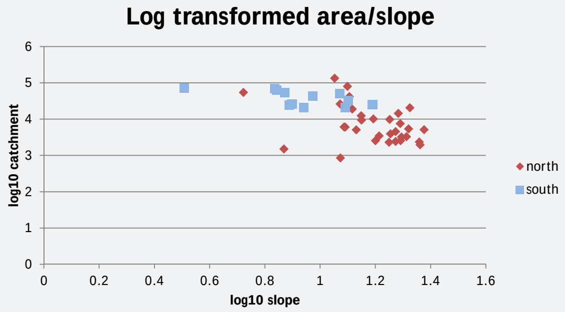




MORPHOLOGY AND DRYNESS

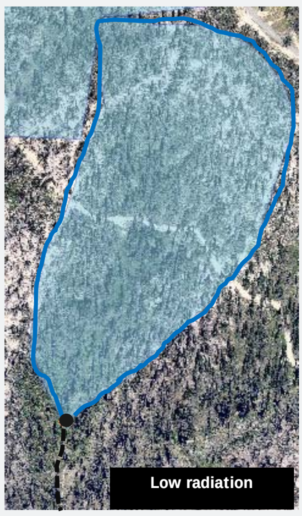
Morphology correlation with aspect



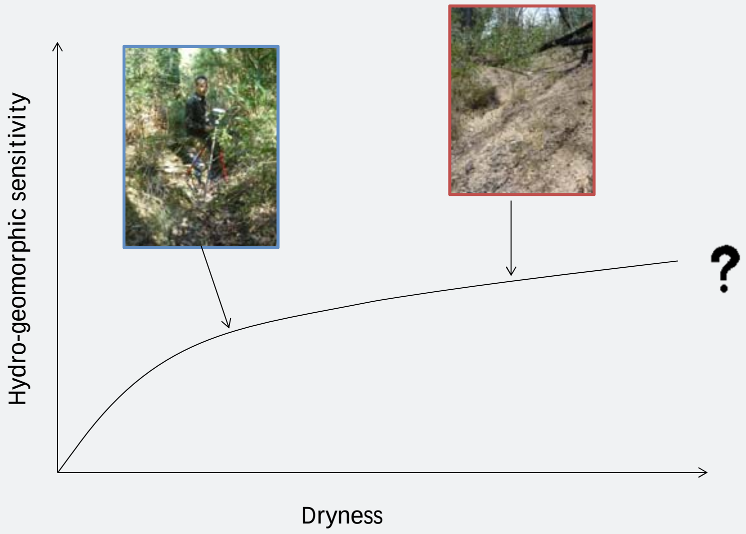


Aspect correlated with dryness

MORPHOLOGY AND DRYNESS



SENSITIVITY AND DRYNESS



THE FUTURE

1. Investigating hydro-geomorphic sensitivity and its causes
2. Modelling/predicting sensitivity levels and risk
3. Develop sensitivity information into useful format for catchment management (mitigation before, during and after a fire)

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